Neutron Sciences

Exceptional tools for studying the structure and dynamics of materials at the molecular level

Spallation Neutron Source (SNS)
The world's most intense pulsed accelerator-based neutron source.

High Flux Isotope Reactor (HFIR)
The highest flux reactor-based neutron source for condensed matter research in the USA.

Why neutrons?

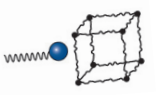
Neutrons possess physical properties that make them valuable investigative tools, complementary to x-rays, in understanding the structure and dynamics of materials at the molecular level. Because the energies of thermal neutrons almost match the energies of atoms in motion, neutrons can be used to track molecular vibrations, movements of atoms during catalytic reactions, and changes in the behavior of materials subjected to outside forces, such as rising temperature, pressure, or magnetic field strength.

Neutron Properties

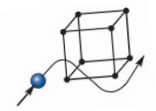
Neutrons are NEUTRAL particles. They
- are highly penetrating,
- can be used as nondestructive probes, and
- can be used to study samples in severe environments.

Neutrons have a MAGNETIC moment. They can be used to
- study microscopic magnetic structure,
- study magnetic fluctuations, and
- develop magnetic materials.

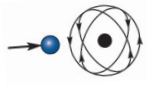
Neutrons have SPIN. They can be
- formed into polarized neutron beams,
- used to study nuclear (atomic) orientation, and
- used to distinguish between coherent and incoherent scattering.



The ENERGIES of thermal neutrons are similar to the energies of elementary excitations in solids, making them useful in the study of
- molecular vibrations,
- lattice modes, and
- dynamics of atomic motion.



The WAVELENGTHS of neutrons are similar to atomic spacings. They can determine
- structural information from 10^{-13} to 10^{-4} centimeters and
- crystal structures and atomic spacings.



Neutrons "see" NUCLEI. They
- are sensitive to light atoms,
- can exploit isotopic substitution, and
- can use contrast variation to differentiate complex molecular structures.

Research areas include:
- Chemistry
- Crystalline materials
- Disordered materials
- Soft matter
- Magnetism and superconductivity
- Life sciences
- Structural biology
- Complex fluids
- Condensed matter
- Polymers
- Materials chemistry
- Applied engineering and materials

Access to these ORNL research facilities is available through submission of proposals. This process is described at http://neutrons.ornl.gov.

General user proposal call deadlines:
August 25, 2010
March 2, 2011
September 14, 2011

Neutron Scattering Educational Resources

ORNL is home to the Neutron Scattering portion of the National School on Neutron and X-ray Scattering (NXS), which educates graduate students about the uses of major neutron and x-ray facilities. Lectures by top researchers from academia, industry, and national laboratories include basic tutorials on the principles of scattering theory and the characteristics of the sources, as well as seminars on the application of scattering methods. Students also participate in supervised experiments at Argonne's Advanced Photon Source and Oak Ridge's Spallation Neutron Source and High Flux Isotope Reactor facilities.

Lecture videos and notes on the following topics from the 2010 School are available at http://neutrons.ornl.gov/conf/nxs2010/index.shtml:

- Interaction of X-rays & Neutrons with Matter
- Neutron Instrumentation/Optics
- Powder Diffraction
- Quasi-elastic Neutron Scattering
- Magnetic Scattering
- Small Angle Scattering
- Neutron Polarization
- Powder Diffraction Applications
- Single Crystal Diffraction
- Small Molecule Crystallography Applications
- Neutron Sources

The NXS target audience is graduate students attending U.S. universities and majoring in physics, chemistry, materials science, or related fields.

Registration for the 2011 School will open late in 2010. Visit http://neutrons.ornl.gov for details, or e-mail neutronsciences@ornl.gov for more information.

U.S. DEPARTMENT OF ENERGY | OAK RIDGE National Laboratory | HFIR | SNS

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